Transient Stability Example 1

Objectives:

1. Determine Critical Fault Clearing Time (CFCT).
2. Observe first swing and second swing unstable situations.
3. Discuss other interesting things.

Steps:

1. Load Project
   - TS_IEEE9Bus.
2. First Run
   - Create a study case FaultLine3 (a sustained fault).
   - Run FaultLine3 and check generator rotor angle plots.
   - Identify G2 rotor relative rotor angle reaches 180º at approximately 0.341 sec. @ 1st swing.
3. Second Run
   - Add an action to open Line3 at 0.3 sec. (< 0.341 sec.).
   - Rerun the case and check generator rotor angle plots.
   - Identify G2 rotor relative angle reaches 180º at approximately 0.351 sec. (> 0.341 sec.) @ 1st swing.
4. Third Run
   - Reduce the action time to open Line3 to 0.2 sec.
   - Rerun the case and check generator rotor angle plots.
   - Identify G2 rotor relative angle reaches 180º at approximately 0.461 sec. @ 1st swing.
5. Forth Run
   - Reduce the action time to open Line3 to 0.14 sec.
   - Rerun the case and check generator rotor angle plots.
   - Identify G2 rotor relative angle reaches 180º degree at approximately 2.911 sec. @ 2nd swing.
6. Fifth Run
   - Further reduce the action time to open Line3 to 0.138 sec.
   - Rerun the case and check generator rotor angle plots.
   - G2 rotor relative angle is less than 137º during the entire oscillation.
7. Conclusions
   - Critical Fault Clearing Time (CFCT) = 0.138 sec. (= 8 cycles).
   - Usually give one cycle transient stability margin. So CFCT = 7 cycles.
8. Final Run
   - Set the action time to open Line3 to CFCT = 7 cycles = 0.116 sec.
   - Rerun the case and check generator rotor angle plots.
   - G2 rotor relative angle is less than 115º during the entire oscillation.

Summary Table:

Fault Clearing Time - FCT (sec.)	Max G2 Rotor Angle (^{o})	Time (sec.)	Remarks
Infinite	> 180	0.341.	1st swing
0.300.	> 180	0.351.	1st swing
0.200.	> 180	0.461.	1st swing
0.140.	> 180	2.911.	2nd swing
0.138. (CFCT)	< 137	N/A	N/A
0.116 (with 1 cycle margin)	< 115	N/A	N/A